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ABSTRACT

To determine the effects of instruction and practice in a self-instructional program that had previously proven to be effective, 52 undergraduates were randomly assigned to one of four treatment groups. One received the entire instructional program, the second received only instructional cues and examples, the third only the practice portion, and a fourth no portion of the program. Subjects receiving instruction achieved a significanlty higher mean score than subjects not receiving instruction. Practice did not improve performance. It was concluded that if practice combined with effective instruction did not improve learner performance, then practice time might better be spent on instruction in other skills. (SK)

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THE EFFECTS OF INSTRUCTION AND PRACTICE IN AN EFFECTIVE INSTRUCTIONAL PROGRAM

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ABSTRACT

The present study was conducted to determine the effects of instruction and practice in a self-instructional program that had proven to be effective (80% of the learners who received the program correctly answered 80% of the items on a posttest). Fifty-two undergraduate students in an educational psychology course were randomly assigned to one of four treatment groups. One group received the entire instructional program, a second group only received the instruction (instructional cues and examples) portion of the program, a third group only received the practice portion, and a fourth group did not receive any portion of the program. Subjects receiving instruction achieved a significantly higher mean score on the posttest than subjects not receiving instruction ($p < .001$). Practice did not improve learner posttest performance. If practice, when combined with effective instruction, does not improve learner posttest performance, then the time learners spend completing practice exercises might be better spent receiving instruction on other skills.

THE EFFECTS OF INSTRUCTION AND PRACTICE IN AN EFFECTIVE INSTRUCTIONAL PROGRAM

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Many studies are designed to determine whether one type of instructional material is better than another type of instructional material. However, one type of material might be significantly superior and still not be effective. The present study was conducted as part of a series of studies designed to determine which instructional variables contribute to effective instructional materials. Effective instructional materials, as defined in this series of studies, are materials which enable 80% of the learners who receive the materials to correctly answer 80% of the items on a posttest.

The instructional material used in this study, the Aircraft Instrument Comprehension Program (Higgins, 1973), was developed, field tested, and revised until it was effective. The Aircraft Instrument Comprehension Program is a self-instructional program designed to enable learners to identify which one of four illustrations of aircraft in flight most nearly represents the position indicated on an attitude indicator and a heading indicator. The program had been systematically developed to include instruction (instructional cues and examples), practice, feedback, and an incentive.

Previous studies that had been conducted with the Aircraft Instrument Comprehension Program had indicated that practice,

feedback, and incentive did not significantly affect the posttest scores of learners (Higgins & Kearns, 1973; Higgins, Kearns, & Tenpas, 1974; Tenpas, 1974). Based on these results, it had been suggested that instruction was the major factor contributing to learner posttest performance (Tenpas, 1974). However, practice had only been examined in a study involving subjects who, prior to instruction, were somewhat proficient at performing the task being taught, as indicated by the subjects' pretest scores. It had been suggested that pracitce might make a significant contribution to learner performance in cases where subjects were not familiar with the task (Tenpas, 1974).

The purpose of the present study was to determine the individual and combined effects of instruction and practice on learner posttest performance on an aircraft instrument comprehension task. Learners who were expected to be unfamiliar with the task being taught served as subjects. Two levels of instruction (presence and absence) and two levels of practice (presence and absence) were manipulated in a 2X2 factorial design. The dependent variables that were examined were learner posttest score on an aircraft instrument comprehension task and learner rate of response on the posttest.

Method

Subjects

The subjects in this study were 52 undergraduate students enrolled in an educational psychology course at Arizona State University during the spring semester of 1974. These learners were expected to be unfamiliar with the task being taught.

Materials

The materials used in this study were variations of the self-instructional program, Aircraft Instrument Comprehension Program (Higgins, 1973). This program is designed to teach students to identify which one of four illustrations of an aircraft in flight most nearly represents the position indicated on an attitude indicator and a heading indicator. These indicators are used to determine the aircraft's pitch, bank, and heading. A sample illustration of an aircraft in flight is shown in Figure 1. A sample illustration of an attitude indicator and a heading indicator is shown in Figure 2.

Insert Figure 1 and Figure 2 about here

Instruction in the program consists of one instructional cue and three examples for each of the three concepts presented: pitch, bank, and heading. There are also eight examples in which the various concepts are combined.

Practice in the program consists of one to four practice items following the instruction for each concept. An additional 10 practice items are included at the end of the program. All practice items require learners to identify which one of two or more drawings of an aircraft in flight most nearly represents the position shown on an attitude indicator and a heading indicator. Learners are required to respond to the practice items on a chemically-treated answer sheet which provides learners with feedback in the form of knowledge of correct response.

Procedures

Upon entering their classroom on the day of the study, subjects were randomly assigned to one of four treatment groups. All groups remained in the classroom, but each group received a different set of materials. The instruction and practice group received an instructional booklet with all instructional cues, examples, and practice items intact. The instruction only group received an instructional booklet containing all instructional cues and examples, however, all practice items were deleted. The practice only group received an instructional booklet containing all the practice items, however, all the instructional cues and examples were deleted. The control group received only a posttest booklet, they did not receive any instructional cues, examples, or practice items.

When all subjects were seated, they were told they were participating in an experiment, and that they would receive extra credit toward their grade in the course because of their participation. They were also told that the first page of the booklet they had received explained how they could earn additional extra credit. Subjects were then told to begin reading the booklet that had been given to them.

The first page of each booklet stated that all participants in the experiment would be taking a test and that if a participant's speed and score on the test exceeded a certain predetermined level, the participant would receive extra credit toward his grade in the course. It was also stated that various types of bookets had been

distributed to the participants and that the level a participant had to attain on the test would depend upon the type of booklet he had received.

The last page of each booklet asked each subject to record the time he had finished his booklet and to raise his hand so that a proctor could collect his materials. A proctor checked the completion time the subject had listed, collected the materials, and instructed subjects who had taken the posttest that they could leave. Subjects who had completed a version of the instructional program were given a copy of the posttest by the proctor, who recorded the subject's starting time. When the subject finished the posttest, he recorded his completion time, had his material collected by a proctor, and was dismissed.

Criterion Measure

The posttest that was administered was the Aircraft Instrument Comprehension Test: Form B (Kearns, Tenpas, & Higgins, 1973). The test contains directions, a sample test item, and 36 multiple-choice test items. All the test items require learners to identify which one of four aircraft in flight most nearly represents the position indicated on an attitude indicator and a heading indicator.

Data Analyses

Analyses of data were performed to determine the individual and combined effects of instruction and practice on posttest scores and on posttest rates of response.

Results

The posttest mean scores by treatment are shown in Table 1.

Insert Table 1 about here

The mean score of 29.80 for groups receiving instruction was almost 14 points higher than the mean score of 15.84 for groups not receiving instruction. Difference in mean score between groups receiving practice and groups not receiving practice was less than one point. The results of a two-way analysis of variance, as shown in Table 2, revealed a statistically significant difference attributable to instruction, F (1, 48) = 82.62, $p < .001$. The F-ratios for practice and for the interaction of practice and instruction were not statistically significant.

Insert Table 2 about here

The time each subject spent answering items on the posttest was converted to a rate of responding by dividing the total number of items by the subject's completion time. The mean posttest rates of responding by treatment are shown in Table 3. The mean rates of the

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Insert Table 3 about here

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four treatment groups were all within .25 items per minute from the overall mean rate of responding. The differences in posttest rates of responding did not approach statistical significance.

Discussion

The purpose of the present study was to determine the individual and combined effects of instruction and practice on learner posttest performance on an aircraft instrument comprehension task. The study was part of a series of studies initiated to determine the extent of the contribution of a number of instructional variables to the effectiveness of an effective self-instructional program. The results of the study indicate that instruction contributes greatly to the effectiveness of the program. Subjects receiving instruction, consisting of instructional cues and examples, achieved a significantly higher mean score on the posttest than did subjects not receiving instruction. Subjects who did not receive instruction were able to respond correctly to an average of only 44% of the items on the posttest. Subjects receiving instruction were able to correctly respond to an average of nearly 83% of the items on the posttest.

The powerful effect of instruction may be attributable to the way the instructional cues and examples in the program were developed. The first step in the developmental process was an analysis of the task the learners were expected to perform. An instructional objective, describing the task to be performed, as then written. After the objective had been specified, the information a learner would need in order to perform the objective was determined. Instructional cues and examples, containing the needed information, were then generated. This systematic development of cues and examples, aimed specifically at providing the learner with the inforamtion necessary to perform the objective, may account for the rather high level of performance of

the subjects who did receive instruction.

The powerful effect of instruction on subject posttest performance had previously been hypothesized (Tenpas, 1974). It had also been hypothesized that practice might have a significant effect on subject posttest performance in cases where subjects were unfamiliar with the task being taught (Tenpas, 1974). The mean posttest score (15.07 out of a possible 36) of the control group, the group that received neither instruction nor practice, indicates that subjects used in the present study were, prior to instruction, rather unfamiliar with the task. However, practice did not have a significant effect on subject posttest performance, despite the subjects' unfamiliarity with the task.

Results of the study indicate that practice alone does not enable subjects unfamiliar with the aircraft instrument comprehension task to learn how to perform it correctly. The results also indicate that when practice is combined with effective instruction, practice does not improve learner performance. If practice, when combined with effective instruction, does not improve learner performance, then the time learners spend completing practice exercises might be better spent receiving instruction on other skills. Future research should be conducted to determine whether practice does contribute to the effectiveness of effective instructional materials.

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TABLE 1

Posttest Mean Scores by Treatment

Instruction	Practice		Totals
	Practice	No Practice	
Instruction	28.07	31.53	29.80
No Instruction	16.61	15.07	15.84
Totals	22.34	23.30	22.82

N = 13 per cell

TABLE 2

Analysis of Variance: Posttest Scores

Source of Variation	SS	df	MS	F-Ratio
Instruction	2534.02	1	2534.02	82.62*
Practice	12.02	1	12.02	.39 NS
Instruction X Practice	81.25	1	81.25	2.65 NS
Within	1472.02	48	30.67	

*$p < .001$

NS = Not Significant

TABLE 3

Mean Posttest Rates of Responding by Treatment

Instruction	Practice		Totals
	Practice	No Practice	
Instruction	2.70	2.43	2.57
No Instruction	2.85	2.71	2.78
Totals	2.78	2.57	2.68

N = 13 per cell

Note. Rate of responding is listed as items per minute.

FIGURE 1

Illustration of Aircraft in Flight

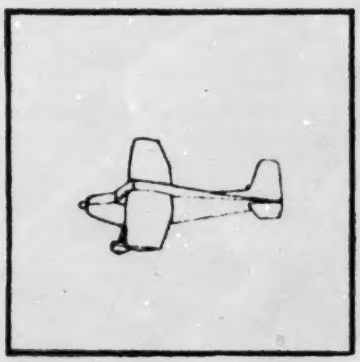

FIGURE 2

Illustration of Instrument Panel